Technology Transfer

A Policy Model

Philip A. Roberts

A National Security Essay

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To the professional people in education, industry, and government who struggle daily to do their jobs, while balancing the benefits of technology transfer against the need to protect the national defense and the proprietary rights of those they serve. *The search for a viable but simple national policy certainly is their dream.*

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Foreword

The exchange of technical knowledge among the United States and other countries can be beneficial, but it may also create policy dilemmas for those nations. On the one hand, sharing new information in areas such as energy generation or irrigation can improve the general welfare. However, the spread of technology with military applications ultimately can damage a nation's defenses. For this reason, and because of potential dangers it presents to national economic interests, "technology transfer" has become something of a contentious concept in international relations.

Philip Roberts argues that the real issue for the United States is not technology transfer itself, but the lack of a comprehensive US *national* policy to guide such exchanges. By default, we have allowed the burden of technology transfer problems to fall upon the government research and development community and private sector contractors. Dr. Roberts proposes a fine-tuned national policy, so that technical information can be made available where and when it will do the most good—and in a way that takes advantage of our open society and certain other characteristics of the American people.

This optimistic assessment of technology transfer tries to get at the root of the problem, rather than just treat the symptoms. With a policy of sensible, cooperative technology exchange, we could compete more successfully in the world marketplace at the same time we discourage the Soviet Union and other nations from acquiring our technology illegally. Roberts' proposals deserve serious consideration by policymakers dealing with the tough issues technology transfer poses for national security.

Bradley C. Hosmer
Lieutenant General, US Air Force
President, The National Defense University

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Technology Transfer:

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1. Toward a National Policy

> If you don't know where you're going, any road will take you there.
>
> —Anonymous

> No one is in charge of Technology Transfer. Each agency (in Washington) seems to be doing its own thing.
>
> —Senior US State Department official

> Something is wrong when it takes six months to get an export license on a product that we are competing for with three other international companies.
>
> —Senior US industrial leader

THE HISTORY OF TECHNOLOGY TRANSFER—and the recent expanding development of high-technology products—have combined to create a serious need for the United States to formulate and articulate a long-term national policy for technology transfer. Government, industry, academia, and the private sector must cooperate in making such a policy work.

I would stress at this point that feats of prowess in the new high-technology environment rarely will be achieved by single nations, private individuals, or technically isolated industrial corporations. Rather, the advance of science and its technological applications are much more likely to result from close cooperation among nations, peoples, universities, professional

societies, and industrial conglomerates. These integrating exchanges are necessary if technology is to be transferred where needed under reasonable rules of trade, business, or national treaties. These exchanges are essential if mankind is to maintain and improve its precarious toehold on this planet for the long-term future.

But what is wrong with the technology transfer situation as it now exists? Do we need only to revise our current practice slightly to foster growth toward new technological heights? To answer these questions, we must examine existing general philosophies and points of view.

During recent travels in Europe and the Far East, I found the following perceptions among Allies and officials of the US Foreign Service:

1. The United States has no clearly stated technology transfer policy, especially a comprehensive or succinct one.

2. Questions about technology transfer in government and industry are important in day-to-day operations, as well as long-term strategic planning considerations.

3. The process of adjudicating a US technology transfer question is terribly long and complicated, and tends to work against US companies in getting contracts when they compete abroad.

4. Technology transfer is the lifeblood of the US commercial process. Yet we have slowly changed the perceived meaning of these words to something associated with the sinister loss of information to the Soviets. Positive aspects of technology transfer with our Allies far outweigh "dangers" of technology drainage to our adversaries. Europeans often voice this point of view.

5. Members of the Coordinating Committee (COCOM) complain that the United States is using COCOM to further its own economic and technological export position.[1] However, the truth is that the United States is not the only "culprit" in the complex maze of COCOM agreements. The Technology Transfer Panel of the House Armed Services Committee reported that COCOM restrictions are often circumvented by member countries either by intent or illegal diversions.[2] More importantly, the United States probably is the leader in the effort to stem the *illegal* flow of technology innovations to the Soviets and their surrogates. The US Department of Defense (DOD) is leading the institutional attack against the unrestricted flow of technology. Other US organizations oppose the DOD efforts.

Two basic points of view concerning technology transfer problems exist in the United States. The two sides involve *free trade* and *controlled trade* perspectives. Any solution or policy involving the technology transfer dilemma must begin with an understanding of this bipolarity. Furthermore, because the dilemma hinges more on decisions about trade control boundaries than on free trade in an open international environment, one must understand the vested interests underlying the controlled trade perspective.

The *free trade* and *controlled trade* viewpoints will be explored in the next paragraphs. Various views of controlled trade advocates and their characteristic interests also will be highlighted. An analogy with a diamond may be useful here: Some of these factional groups will take different positions, depending on the technology, much as a diamond may reflect different colors from the same light. Yet true to the diamond's geometry, the angle of reflection and deflection will be consistent under the rules of optical physics. So may

the views of the differing controlled trade groups be seen.

THE "CAPITALISTIC INFLUENCE" Many—perhaps a majority—of the individuals, companies, and industries who are *free trade advocates* believe that the interests of the United States will best be served by allowing the free exchange of goods and services (with nonmilitary values) among all nations and areas of the world. In the real sense of the words, they represent the "capitalistic influences and philosophy." The idealistic position professed by free traders is buoyed by the successes of post-World War II economies of western nations in general. More specifically, Japan, the United Kingdom, and West Germany indicate extraordinary transformations from war-torn countries to vital high-potential economies. They may have upturns and downturns, but western world economies show tremendous resiliency, as in responses to oil crises and price changes brought on by the Organization of Petroleum Exporting Countries.

The *free trade group* is represented within the US Government mainly by the Department of Commerce. These "free traders" affect policy by the issue of export licenses to US firms. They believe that the more permits the Department issues, the better the overall trade balance will be. In fact, this philosophical pattern is flawed. For example, energy imports are the single most important and costly US trade balance factor. Yet more export licenses will not balance this side of the equation. The real change in the trade deficits we face today could come from developing an alternative energy source and applying conservation measures

vigorously. Table 1 shows the value of US oil imports in 1981. These figures should be compared to the total import value of goods for 1981, about $273 billion.

Table 1
Value of crude oil imports, 1981 (in $ billions)

Saudi Arabia	$14.0
Nigeria	9.0
Mexico	5.8
Libya	5.2
United Kingdom	4.9
Indonesia	4.6
Algeria	3.7
Venezuela	2.0
Canada, United Arab Emirates, Norway, Trinidad, and others	12.8
Total	**$62.0**

As noted recently by the US Department of State, the United States is the world's third largest oil producer after the USSR and Saudi Arabia. Even so, the United States has been a net importer of oil since 1949.[3]

Hence, control of our energy appetite might help the balance of trade. But the free traders' method of import/export rationality would require breakthroughs in technical and economic feasibility in several high-technology areas. Likewise, many experts, observers, and officials feel that *controlled* technology transfer and trade is much the preferred solution.

PROTECTING OUR "TECHNICAL LIFEBLOOD" Advocates of controlled trade, the chief opponents to free trade, believe that the technology arteries of the United

States are hemorrhaging. They see the Soviet Union and other world-class entrepreneurs holding the buckets to catch our technical blood. They see, especially in the communist countries, the collectors also wielding the scalpels that inflicted the arterial wound. The facts certainly verify that other countries are taking advantage of the United States. The real question is what the United States will do about this loss of its technical lifeblood. Can the United States prevent undesirable technical transfers?

Many opinions exist within the controlled trade viewpoint. Though fewer in number than the free-traders, people who advocate controlled trade are more powerful because of their high positions in world political organizations and business-government-financial institutions. Each category of controlled-trade believers—technological strongholders, the government power and process group, the security group, and the industrial faction—has a particular and parochial view of why technology transfer ultimately is harmful to US interests.

- The first group, called *technological strongholders*, is farthest away from the free trade philosophy. They believe that the future technical role of the United States in the world is to become the mecca for and fortified possessor of all of the most advanced technology. This drive for technological supremacy is founded in the Silicon Valley logic of electronic invention and discovery. In addition, this subset of controlled-trade believers is inherently patriotic, hardworking, and conservative. In spite of these potentially laudable traits, they tend to be myopic. They do not look into the strategic future because they are absorbed in the near-term technical complexity of a certain product. Or they are too involved in the

entrepreneurship associated with exciting and profitable discoveries.

These *strongholders* feel that we can feed the technological discovery engine from within our own nation; that no interchange is required with other technical centers of the world because we are so far advanced. These advocates even believe that a discovery in the garage, basement, or den after a thousand failures is *the* mode and manner for all future technical advancements and the national technical supremacy.

Thus, competition is not essential because of the entrepreneur's basic drive for success. Recently this position has been debunked by events in several nations. As one example, Japan adopted a goal of electronic and software supremacy and subsequently has engaged the United States in a competition that is pushing both of these nations well out in front of all other world competitors. The other side effect has been the realization by many people that the United States cannot adopt a closed, insular attitude toward technical exchanges. In fact, some cooperative efforts with the Japanese were spawned as a result of this competition.

The fierce competition that results from today's high-stress financial environment fosters possessive characteristics and protectionism. Out of these fears arise the control enthusiasts who feel that all good products and their basic technical building blocks should be kept within the United States. Easy to see is the genesis, then, of the conflict between people who believe in free trade and people who want a castle treasury of absolutely invincible technology. Attempts have been made to identify and describe the current US treasure trove of "unmatched" or highly critical technologies. In fact, the DOD has created an

extensive Military Critical Technology List (MCTL) indicating specific items that should be protected by the United States for security purposes.

This list includes most of the highly advanced electronic chip techniques, for they are integral parts of next-generation weapon systems that use astounding computational speeds and new storage and retrieval successes. But this protection in the name of security does not allow the US electronic industry to market its goods around the world, and sometimes not even within the essentially free US market.

The need to protect US security certainly is not arguable on any terms. However, to constrict markets for these exotic electronics to protect a few military systems is to make the cost of the weapon systems exceptionally and artificially high. Some trade-off must be made between concerns for security and needs to foster markets for advanced technologies. Some alternative solution must exist to the high-castle-wall (with moat) psychology.

Some of the other groups affected by the idea of a technological bastion and its protectionism include much of academia and many professional societies. The DOD recently became embroiled in a controversy over the classification of technical papers, restrictions on conference attendance, and restricted publication rights. Although this problem was born out of the need to protect security, diverse opinions exist on this subject. At the moment the jury is out.

Dr. Richard D. DeLauer, former Under Secretary of Defense for Research and Engineering, notes in a recent article in the magazine *Science* that the "conflicting imperative of national security and open scientific communications have been the subject of a

vigorous and sometimes emotional national debate." DeLauer continues,

> Differing priorities have led to incompatible conclusions. In times of peace and security, the maximum freedom of speech and communication has served this nation well; in times of great peril, national security considerations have temporarily displaced those precious freedoms.... The potential for unintentional disclosure of national security information through the publication of basic research results is virtually nonexistent, and the benefits of such an open publications policy far outweigh the risks.[4]

Also evident is the fact that the advancement of technology depends on the widest possible freedom of international academic interchange. New restrictions on technology transfer pose a potential threat for US technical journals, warns George Sutton, editor-in-chief of the *AIAA Journal*.[5]

"Publication in a US journal is considered technology export," Sutton writes in an editorial, "because US journals are mailed abroad, and foreigners may read them in US libraries." Sutton continues,

> But now we have DOD Directive 5230.25, which restricts export of unclassified technical data of 'critical technology with military or space application.' To determine what is critical, one then looks at the Military Critical Technology List, which is about 100 pages long. Since the unclassified materials listed therein are proscribed from export, not only can they not be presented at technical meetings having foreign attendance but they *cannot* be published, even in the United States.... Our technology depends on *rapid* and *complete* access to technical data which has been *refereed*. The referee process increases the accuracy of

> the net body of technical data. Access is provided, not by a bureaucracy, but by indexes of technical journals including on-line, key word, real-time computerized search systems.

The new restriction on DOD-generated technical data and its potential extension to all technology, regardless of the funding source, Sutton warns, "will end our present technical meeting and journal structure." Without this structure, Sutton states,

> technical journals will falter, because it will become a nightmare firstly to locate technical data ... and secondly to determine their mobility.... Our regulators seem to believe that technology is something like gold: once we have it, we can bury it such as in Fort Knox under lock and key, and let only 'authorized' persons gain access to it.

The implied compromise that "university" research is basic research, and not subject to the same restrictions, Sutton writes,

> is an insult to government and industrial groups. As for 'compartmentalization,' this is surely the end of innovation, which comes from a synergism of different fields. How can we have ... ceramics metals if metal technology is compartmentalized from ceramics technology?

It's clear that technology transfer must be as free as possible!

Researchers gain insight and initiative from exposure to other ideas and questions. Therefore, the free exchange among intellectuals, except in very rare instances, must be protected by every individual, company, and government in the Free World. This

collective intellectual communication must continue if we are to maintain the credible lead that we collectively possess over the nations that profess restrictive ideologies. Communications and exchange are vital to our nation's continued existence.

● The second subdivision of controlled traders, the *government power and process group*, is one of the most powerful and prolific in the technology transfer community. These members of the bureaucracy are articulate and innovative. They do not belong to any one agency. In a sense, these individuals hold that all problems are solvable if money and people can be assigned within the bureaucracy to implement new or existing rules.

They generally believe that all of the ripped seams in technological controls or free trade can be mended merely by restitching the rules of government, by changing the power and process relations for controls, or by legislating the problem away. By way of example, the Export Administration Act basically is a good piece of legislation that is flawed by the singular absence of any long-term policy for technology transfer.

To identify and further isolate these *government process* people is difficult, for they tend to have widely disparate views about the proper amount of trade control or freedom to allot to the various technologies. One common value seems to exist throughout the process faction, however. They all seem to have articulate explanations about why changes should be made in the directions that they feel are right and just. These changes, though, if put to the test of practicality, would seem to alter the power centers without changing the overall technology transfer situation or philosophy. These few individuals are not able (or

aren't trying) to see beyond their own experiential background and prejudices induced naturally by their employment and environment. They mean well, but I believe they have lost sight of strategic long-term goals of the United States.

- The third faction of controlled-trade strongholders, the *security group*, consists of Government and private industry people. The Government sees every transaction of technology outside the United States as a threat to the continued existence and superpower position of our country. The private industry people see the loss of any manufacturing technology, or the quality-control process for some product, as a failure of industrial security to protect a product line that could have yielded another round of profits for the company.

This philosophy touches at the core of the belief in capitalistic competition. But quite possibly their current profit position on a certain product line is the result of a positive technology transfer from someone or somewhere outside their own company. This profit position certainly is not the result of absolute or perfect security.

The one possible exception to this situation could be the single individual entrepreneur who invents and is able to market some item without help. But very few of these single-person/single-item success stories exist. Further, these singular situations rarely last for more than a few months or perhaps a year at most. For example, consider the transient nature of success in the computer software world. IBM is an exception to this rule because it handles technology transfer in a very doctrinal and long-term manner.

- The pivotal people and companies in the fourth controlled-trade group, the *industrial faction*, rest

approximately in the middle between the two extremes of free trade and controlled trade. Perhaps the motivation of this group, which represents the heart and blood of the US economy, is to create a commercially viable product, turn a profit, and perpetuate the process by supporting research for new and better products. These incentives seem to be the only real examples of a nationally consistent logic and reason in the world of technological transfer. Most individuals within this group recognize the need for national security, and support the restriction of flow of certain technical information in the name of US national security. Less agreement exists on the restrictions necessary and associated with general mass-production items.

Most of the people I talked with indicated that although most technology should be marketed and sold at the earliest possible time, research and laboratory improvements are areas in which the restrictions should be the most severe. Of course, this view only highlights the question of free trade versus the technological bastion.

Technology transfer is both good and bad, depending on the way we view it—just like the diamond in the analogy earlier in this chapter. How do we begin the task of finding alternatives and answers to some of the problems voiced by the various factions?

Let's begin with some recent history.

2. The Background

United States policy governing East-West trade and technology transfer is in need of a major overhaul.

—Gary K. Bertsch, "East-West Trade and Technology Transfer: Toward a Policy of Non-Military Free Trade," *SAIS Review*, Summer/Fall 1984, Vol. 4, No. 2, p. 93

TECHNOLOGY TRANSFER IS NOT NEW. Speculation among self-appointed scholars about the first transfer of technology and when it may have occurred is widespread. Some people speculate that the first real technology transfer occurred before recorded history, with the manufacture and field operational training for use of standard issue M-2A/B, "Caveman Club—Without Nail." More serious scholars indicate that understanding how to start and maintain fires was the first technology transfer of consequence in human history.

Countries and political entities historically have used technological prowess to maintain military ascendency over others. From caveman clubs to hypervelocity missiles, technology transfer has played a significant military role; it also has assisted imperialistic expansions and conquests. On the other hand, higher standards of living, safer working conditions, and improved medical care are three of many major benefits of technology transfer. Thus, though technology transfer is not always an agent for mankind's good,

neither is it simply a demon that threatens our existence.

In fact, whether technology transfer is good or bad depends on the use and morality of the possessor. For example: The USSR has no compunction about its noncooperative technology transfer from the United States. The US Government views this activity as *stealing* our national intellectual rights. On the other hand, we can view technology transfer to the Soviet Union as good if it raises the Soviet standard of living, increases Soviet contact with the rest of the world, and raises consumer demand for products from the Free World.

"HEMORRHAGE OF TECHNOLOGY" A concerted effort for transfer of western technological ideas to the USSR has been in effect as a basic policy of the Soviet Union for some time. Traceable to the 1930s, this bleeding of western technology for the advancement of Soviet technology has only recently been given attention at senior policy levels and in the news media. The use of the phrase "hemorrhage of technology" by members of Congress and senior administration officials shows their present concern.[6]

In the past few years, the Free World, especially the United States, has realized that the Soviet Union's technology acquisition through overt and covert means has cost western nations billions of dollars. Practically speaking, the United States has lost an undetermined amount in opportunity costs. One DOD study shows that the potential loss to the United States alone could be more than $14 billion in military research efforts over the period of 1985 to 1997. This study specifically projected the costs of responding militarily to the lost or stolen technical expertise associated with 79

different exports that recently have been denied to Eastern bloc countries.[7]

US reaction in the 1980s has been to tighten controls and attempt to restrict the flow of technology to Eastern bloc countries. This protective control has been instituted under the recent ideological leadership of Richard Perle, former Assistant Secretary of Defense for International Security Policy. His articulation of the problem, and his skillful handling of very difficult international issues with COCOM and our NATO allies, have won acclaim, especially in the controlled trade faction.

The swing to protectionism, though, has grave implications for US trade balances. And its influence reaches all the way back through the production and development process into basic research at our universities. Mr. Perle once had the upper hand in the struggle with the free trade faction of Government. However, long-term US economic implications are very uncertain, and need serious study before extensive technology protectionism is invoked.

FUEL INJECTION EXAMPLE Until this decade, freedom of information flow has been the byword of industrial progress. In fact, a principal reason for the astonishing revolution in high technology in the United States is the unrestricted flow of information within and outside the US academic community. This cycling of problems and state-of-the-art answers has been a model for technical advancement and expanding trade throughout the western world. As an example, consider the successful transfer outlined by Jack Baranson in his case study of the licensing of Bendix electronic fuel injection technology to Bosch.[8]

The Bendix Company had pioneered the development of electronic fuel injection for automobiles. However, the market for electronic fuel injection opened earlier in Europe than in the United States. Since Bendix had the earliest US patent rights, export of cars to the United States might be affected, so in 1968 a deal was struck. Bosch, a German manufacturer of automobile components, used Bendix expertise on its systems for European cars. Bosch improved on it to a point in the late 1970s that technical capability was transferring back from Bosch to Bendix.

The electronic fuel injection example is just one of millions of international and intranational transfers that result in successful products. Hundreds of examples could be given covering international military technical cooperation as well. The real question seems to be: *How much* technical information can we share and still protect the US edge in superior quality weapons systems?

One persuasive argument goes like this: We must avoid the reversion to secrecy and protectionism if we hope to maintain our leadership in military technology and to continue to share cooperatively with the Free World technical community. The secrecy and protectionism that exist in the Soviet Union and its affiliates and surrogates have doomed them to always being behind the West. Although we should be pleased with this certainty, it also seems reasonable that we should make stealing our research and development advancements more costly to the Soviet bloc.

Further, we should raise the cost to anyone else who would surreptitiously gain western-world technology in an attempt to profit without just compensation to the initial inventor or author. Finally, though, we should avoid the fanatic controls and secrecy that have

retarded the indigenous Soviet potentials for modernization.

The problem has become more acute in recent years, because the Soviets have had a major commitment since the 1960s to repair the strategic imbalance that caused them such a problem during the Cuban missile crisis. To catch up, they use western high technology adapted to Soviet needs and operational requirements.[9]

At the same time, our oil imports have contributed to a trade imbalance that has forced the United States to emphasize exports artificially. As a consequence of this trade-related economic imbalance, export licenses might at first impression seem to be easy to get.

"DUAL USE" PROBLEMS The current export license policy, however, is not clear nor is the process simple. Some license requests have been denied for no apparent reason except that the equipment or part might be of "dual use." "Dual use" means that a *possibility* exists that it may be used in some armament system. This reasoning confounds some US industrial managers and companies, because the same type of equipment often is available from other foreign-based international companies. Consequently, US commercial companies lose business. As examples of the problems of commercial sale of goods abroad, figures 1 and 2 show the approved process for selling articles listed on the US Munitions Control List.[10]

After minimum investigation, one finds that the difficulty lies in the combined effect of each US Government agency looking at this export problem from its own perspective. *No single agency is chartered to consider technology transfer from the vantage point of*

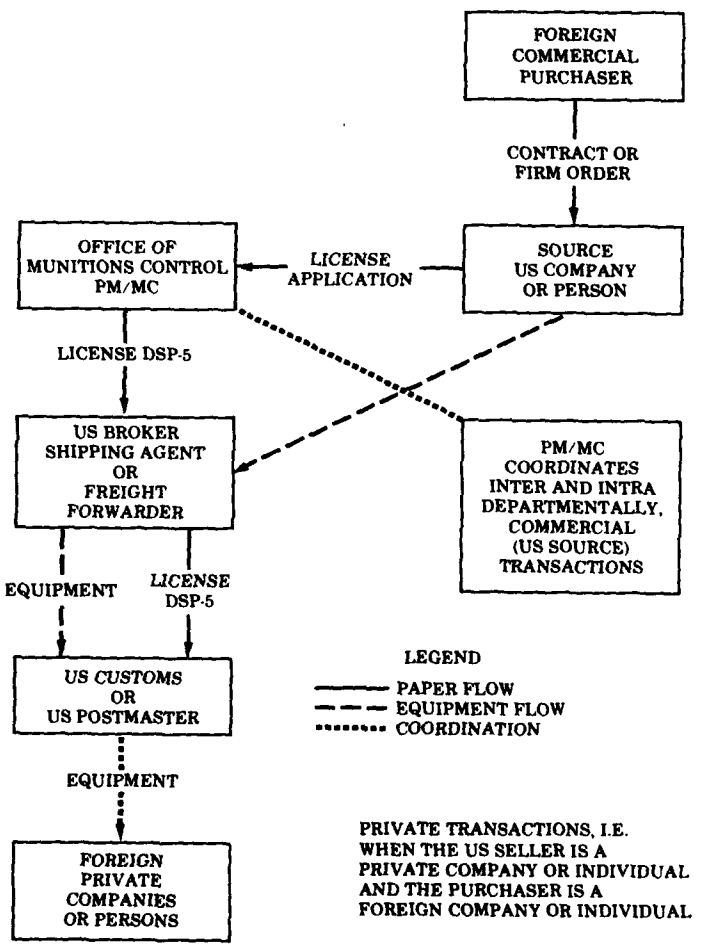

Figure 1. US commercial sale to foreign commercial purchaser
(Processing exports of US Munitions List articles)

(Source: Department of State, Office of Munitions Control letter dated 3 March 1980)

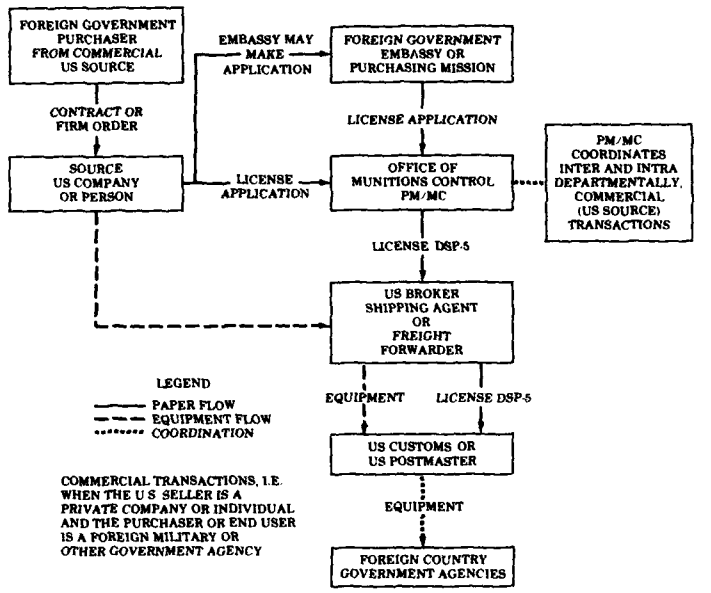

Figure 2. US commercial sale to foreign government purchaser
(Processing exports of US Munitions List articles)

(Source: Department of State, Office of Munitions Control letter dated 3 March 1980)

long-term US national interests. Not even the National Security Council (NSC) has the resources or charter to do more than examine or investigate exceptional cases. Nor should the NSC be given such a charter.

INTERAGENCY SQUABBLES Interdepartmental squabbles over which agency should investigate and enforce

trade regulations arise because of unclear direction and because the agencies are concerned with interpretations at different policy levels. These concerns manifest themselves variously as agency policy, enforcement procedures, philosophy, perceived national interests, public image, individual prowess, and allied cooperation. The result, as seen by other nations or by US exporting industries, is a poorly focused, confusing policy. Interagency squabbles inevitably result in internally inconsistent rulings on exports, and arbitrarily restricted export licenses.

The inconsistencies are further aggravated by agency differences about who should enforce and oversee the policy on technology transfer. The US Customs Service (Treasury Department) and the Commerce Department have major responsibilities for implementing decisions about particular exports. Even though responsible people are trying to promote cooperation in an atmosphere that lacks overall guidance, bureaucratic nightmares result from turf battles.

For example, the first paragraph of a memorandum of understanding between the Department of Commerce and the US Customs Service, concerning overseas enforcement of the Export Administration Act, should be sufficient to reveal the confusion in enforcement. The memorandum sets forth the manner

> in which investigations of violations of the Export Administration Act shall be handled outside of the United States. The procedures set forth herein pertain to investigations of export control violations and not to general enforcement policy matters or to pre-license checks and post-shipment verifications unconnected with such investigations. Such general enforcement policy matters, pre-license checks, and post-shipment verifications shall be conducted exclusively by Commerce except that Customs may render such assistance as may be requested by Commerce.[11]

This failure to define clearly the lines of enforcement responsibility is not the direct fault of any agency. Rather, it signifies the executive department's failure to generate overall policy and provide policy guidelines to ensure that the management of laws, procedures, and directives for technology transfer is efficient and effective.

In the current political environment, what could alter the jurisdictional problems?

The first, and perhaps most important, step is to establish a clear definition of technology transfer. Then, this definition must be agreed to and announced by the most senior executive in the US Government, for we must ensure that each actor in a transfer is communicating from a common basis of understanding. Following the announcement, the definition of technology transfer must be standardized throughout the country, and then with our friends and Allies.

The two components of the term "technology transfer" might be defined as follows:

Technology is the understanding and application of scientific knowledge, technical information, know-how, critical materials, unique manufacturing equipment, end products, and test equipment essential to research, develop, produce, and use state-of-the-art items or systems.

Transfer is the communication of information materials, or equipment, from a sender (the entity or person who possesses desired data or materials) to a receiver (the entity or person who obtains the data or materials).

3. The Quintessential Issue

CONSIDERING THE COMPLEXITY OF THE UNITED STATES, the variety of its interests, and the staggering size of its bureaucracy, the problems and the history we have briefly reviewed are not surprising. But although they contribute to the principal problem the nation has with technology transfer, they are not its quintessence.

Stated succinctly, the quintessential technology transfer problem is this:

The United States does not have a long-term policy for technology transfer.

Although certain procedures exist for restricting security- related material or arms sales, or for controlling export licenses, these procedures are forged out of concerns for limited time frame items and are not the result of a long-term policy interpretation. The problem logically separates into a dilemma of how to balance the process of open communication, while restricting items vital to our future security and national safety.

Perceptions

Fundamental to technology transfer are the varying perceptions in communications between individuals. For example, consider the differing understanding by citizens of the United States and the People's Republic of China (PRC) when "technology transfer" is mentioned. The Chinese understand this two-word phrase

to mean the transfer of specifications for a part, a system, or a product, in return for money or access to Chinese markets, or other rights.

In their understanding, *no* US technical personnel would be needed nor would the Chinese slowly evolve from piece-part construction, to system integration, to final autonomous capability. Technology transfer to China is simply a handover. A US technical individual or manufacturer, however, would interpret "technology transfer" to mean a long-term learning process involving technicians, scientists, and managers from both countries working toward a future goal of Chinese autonomous production capability for one product or similar sets of products.

Naturally, a payment for these activities is expected by both parties, but this illustration also hints at a larger issue: How much, and what should we be willing to transfer? What protections are necessary for long-term national interests?

Restricted or Free Trade?

The problem of restricted or free trade is on the minds of many Americans because the dichotomy of free trade versus restricted trade hits us in the pocketbook! On one hand, we could recoup part of our investment in research by allowing technology export to occur at the highest rate consistent with monetary policy. The world wants to buy many manufacturing capabilities, or quality control pieces, or finished products from the United States.

On the other hand, some protectionists hold, for example, that the luxury of selling five or ten thousand personal computers and compatible software to Soviet scientists might endanger some of the engineering and technical leads that we hold today.

Such a problem cannot be solved on a piece-part basis. And, practically, if we don't sell to them, someone else will!

Another example of the nature of the problem is the new trade potential with Communist China. Free trade advocates see vast new capital markets with more than one billion Chinese people as consumers. The technology of personal computers also could assist the Chinese in repairing the ill effects of education during the Cultural Revolution. But US protectionists argue that the Communist Chinese may overtake us in educational quality and are seeking very advanced production models of military aircraft, naval weapons, and army systems.

While this argument is true on its face, Chinese production ability lacks the broad base necessary to accomplish this overtaking. Although they recognize the need to build this capacity, they also are aware that it will require a long-term building process, which will include education and training. Consequently, Chinese requests must be evaluated carefully, in light of long-term US interests and the interests of our Southeast Asian friends.

How do we separate the effects of technology transfer in personal computers from that of laser gyroscopes? Obviously, at the moment the question is moot. To our detriment, a typical example of the paralyzing effect of US technology transfer policy indecision was cited by State Department officials in Hong Kong. Texas Instruments had applied to the export controls office to sell an electronic product to Communist China, but the US bureaucracy took six months to respond. By that time the deal was less lucrative for China or Texas Instruments. Since the product reportedly was neither military nor connected to military capabilities, the delay and loss are not reasonable.

In the words of one consulate official in Hong Kong, the "US technology transfer policy is idiotic" as it is practiced today. This statement is not an indictment of the people who carry out current procedures. Rather, it is a clear sign of the urgent need for careful thought and creation of a strategic national policy for technology transfer.

Specific Considerations

The debate over controlled versus free trade has been cited earlier. Where to draw the dividing line—to ensure continued US security, yet promote reasonable growth of trade and commerce internationally—remains a problem. The specific case of VAX computers being sent to the Soviet Union via surreptitious third-party transfers has drawn attention to the need to determine a *practical line of demarcation*. Is it good business to hold back the sale of items that we already plan to improve? In the VAX case, this basic question was subverted because US national security was directly threatened by Soviet use of these computers to assist in their intercontinental ballistics missile targeting and retargeting.

LIMNING PROCESS Thus, one specific decision line must be indelibly drawn—that is, when the transfer results in demonstrable adverse effects on US national security. In this limning process, we must consider the technical competence of the adversary and whether that adversary could make use of a particular military technology. We also must consider whether the United States intends to share the particular technology with its Allies and trading partners.

One current example will illustrate. Assume that the PRC has indicated its desire to acquire certain

western technology. China specifically has requested help from the United States in return for certain trade concessions and various academic exchanges. How the United States handles this request, and the many that would follow a positive US response to China, well may be the cornerstone for a new policy. But the reality is that negotiations with China are proceeding today with no long-term policy either set down or announced. Therefore, the best we can hope for is an outcome from which we can recover, and which is not detrimental to current US interests.

The US-PRC relationship indicates some of the administrative problems in the technology transfer decision process. Decisions to pursue closer ties with the PRC on cultural and technical levels obviously have been made at the highest US Government levels. However, senior government officials have had to be involved in the specifics of the transfers, a time-wasting practice. Then the operational agencies of our Government have to react to these decisions, or support departures from the announced decisions, either of which causes further delay.

The main reason for this mess is that no officer of the US Government actually is in charge of the implementation. And implementations left to the Senior Interdepartmental Group or its agencies have proved no exception. This fundamental procedural problem has afflicted the American capability for technology exchange to the extent that decisions are now made at management levels much higher than required, reasonable, or necessary.

Unfortunately, the opposite also is true. Major decisions affecting long-term policy often do not get to the highest levels because of the protective bureaucracies below. High government officials should

be planning and implementing policy, not making specific decisions that retroactively set policy. Allowing this problem to continue results in reduced efficiency of government agencies and, as stated before, economic losses to US commercial systems.

DISCLOSURE OF DEFENSE INFORMATION Public disclosure of defense information that might be subject to export controls is another coefficient of the lack of a national technology transfer policy. As a theoretical example, the Soviet Embassy might commission a private individual in the United States to use the Freedom of Information Act (FOIA) to request unclassified but important data on space shuttle tracks over the earth. From this FOIA information, the shuttle's capabilities to assist militarily significant satellite launches could be extrapolated or extracted. Because of this possibility, agencies act on their own to safeguard information.

Recently, Arthur Fajans noted in an article in *Defense 85* that the DOD has revised its policies for marking technical documents.[12] One defense measure to reduce the unauthorized flow of information, Fajans writes, requires seven statements that collectively provide a range of options—from unlimited distribution to no distribution without specific authority of the controlling DOD office. The seven authorized distribution statements follow:

1. *Distribution Statement A.* Approved for public release; distribution is unlimited.
2. *Distribution Statement B.* Distribution authorized to US Government agencies only. Other requests will be referred to the controlling DOD office.

3. *Distribution Statement C.* Distribution authorized to US Government agencies and their contractors. Other requests will be referred to the controlling DOD office.
4. *Distribution Statement D.* Distribution authorized to the Department of Defense and DOD contractors only. Other requests will be referred to the controlling DOD office.
5. *Distribution Statement E.* Distribution authorized to DOD components only. Other requests will be referred to the controlling DOD office.
6. *Distribution Statement F.* Further dissemination only as directed by the controlling DOD office.
7. *Distribution Statement X.* Distribution authorized to US Government agencies and private individuals or enterprises eligible to obtain export-controlled technical data under regulations implementing Title 10, Section 140c, United States Code (10 USC 140c). Other requests must be referred to the controlling DOD office.

Note that these seemingly logical controls have a pervasive effect on DOD and Military Service documents, an effect that delays the release of a document and multiplies control problems. And, again, while they recognize the need for a broad national policy, they remain a piece-part approach to situations that come up.

FOREIGN POLICY PROBLEM The foreign policy decision process associated with US Government international relations makes enforcement and control

problems awesomely complex. If we consider that most technical transfer cases or applications are rather easy to assess technically, the real difficulty stems from the addition of complex international politics and the necessity for positive decisions to share information or technology with other nations. A quid pro quo in the technical sense may not be required, but some return, such as basing rights, might be requested. Now the question arises as to how to equate these diverse payoffs: for example, basing rights versus technology.

Although such a foreign policy problem often involves people in the highest levels of the US Government, on a practical basis these individuals cannot spend all their time overseeing foreign policy implications and making decisions on technology transfer matters. The day-to-day policy oversight might well be handled by the Senior Interdepartmental Group currently chaired by a deputy under secretary of state. But this group should not be forced into daily or even weekly technology transfer decision requirements.

DIVISION OF POWER Added to problems with the dividing line, the disclosure of information and complications of foreign policy are problems of the division of power and management of resources. Policy overview should reside with one executive manager. No single agency or person is now assigned this responsibility or authority.

The President's Office of Science and Technology Policy (OSTP) seems to be the most logical place for this power to reside. OSTP officials have indicated that a permanent advisory group of scientists and engineers could provide technical policy recommendations at operational and technical levels, as well as serve as technology policy watchdogs.

INTELLIGENCE The Director of Central Intelligence has chartered a Technology Transfer Intelligence Committee to coordinate intelligence assessments on technology transfer. But this excellent resource is not part of any decisionmaking process. The Director of Central Intelligence advises policy makers and decisionmakers only when asked.

A longer-term outlook and clear policy would allow the committee to respond significantly, and direct its vast resources to specific concerns of user authorities.

INTERNAL STAFFING Added to the problems outlined above is the unrest caused by uncertainties over the longevity of executive departments. The ideal solution for technology transfer control might be a division within the proposed cabinet-level Department of Science and Technology, or with a new Department of Trade and Industry. Sharing a national technology transfer policy between these two proposed agencies could repeat our current dilemma, with still no one in charge.

In the planning process for the new departments, perhaps an under secretary could be assigned to a position for technology in, say, the proposed Department of Science and Technology. Such action would preclude interface problems and remedy the chaos of power assignment that exists today.

Can all these problems be solved, while still maintaining a government agency that is not handcuffed by regulations and overstaffed to the point of paralysis? It would be possible if we could find a practical, far-reaching statement of US technology transfer policy. But before we attempt the statement of national technology transfer policy, we must establish common

principles for the technology transfer business. As in the physics of the many-faceted diamond mentioned in chapter 1, certain binding principles already exist for technology transfer.

4. Principles

IN LIGHT OF CURRENT STATED US NATIONAL OBJECTIVES, since certain principles of technology transfer presently exist, a long-term statement of national technology transfer policy is possible. Stating the policy is one thing; its practical implementation is another. But both of these goals are attainable.

Let us examine certain basic principles extrapolated from the practical experience of technology transfer—control, timing, relinquishment, profit (or loss), and status.

1. **CONTROL**—To retain a unique capability the possessor of technology must have the means of protection, enforcement procedures, and an effective means of communicating this barrier to all who would attempt to break or broach the protective apparatus. If any of these procedures is not viable, control of the technology eventually is doomed to failure.

The meaning and consequences of "unique capability" are most important to this principle. Consider the Soviet pipeline episode. The United States clearly had the most modern and efficient pump technology in the world. However, US pumps were not the only ones available nor were they absolutely necessary to complete the project. This technology was not "unique" because other countries and industries had similar, albeit not quite as efficient, capability. Other

countries were quite willing to sell their wares to the Europeans and Soviets with little or no concern about Soviet use of the equipment in the future.

Although the United States had other policy reasons for pursuing this technology boycott, the requirements of the principle of control were not satisfied.

Consequently, the lesson from the pipeline episode: If you possess superior technology, others also may possess similar ideas. If others are willing to sell or export their technology, a decision to withhold all types of pipeline technology may not be in the nation's best interest. If the purpose is to protect the very high-technology pump, then you may be considered successful, even though a sale occurred with a competitive country. If your attempt was to impose some foreign policy limitation on a country, then the first requirement is to get cooperation from other people who might see fit to sell their technology to the consumer. This tactic has not been highly successful in the past.

The basic rule of the control principle is the examination of the specific technology to determine if it is amenable to control at all. Suppose the geometric shaping of a house as it is constructed significantly affects the heat transfer characteristics. Once several of these houses were built, the fact that they looked different would be hard to hide. And since the construction company wants to sell these houses, the company will have to advertise them for sale. In this fictional example, the entire industry would be copying the technique or developing similar ones in a very short time. Control (except through a specific patent) is not feasible given the profit motives, timing problems, and industry competition.

The control principle has a corollary: international and multinational possession of technology. Simply

stated, this corollary indicates that *corporations provide their own specific conduits for technology transfer across national borders.* At first glance, greater control of a technology might be anticipated, given that a multinational concern has a monopoly on the technology. However, very few technologies are monopolized on this scale. And practically speaking, the extended exposure of more and more people to a proven capability increases the chances that it will be copied, improved on, or just stolen by someone.

Control of technology implies an understanding of its timeliness for the world marketplace. This view indicates some temporal aspect to our principles, hence the next "principle of timing."

2. **TIMING**—The opportunity to control or expand the influence of a technology is fundamentally affected by the right timing.

In the broadest sense, this principle indicates that peak periods of demand exist for a particular technology. In today's high-technology world, demand for an item may be limited, may be a "fad." Fads occur in the fashion world, but they also happen in the high-tech electrical or mechanical world. Examples include video games, "all-knowing" chronometer/computer watches, and a countermeasure for some recently invented radar counter-countermeasure. The longer the period between the rise and fall of the product popularity, the more control that is necessary to protect the unique portion of the technology.

Certain technologies are enduring. For example, the use of fire or heat to cook and to change the properties of substances has been used for thousands of years. Methods by which this capability is achieved are

being modified continually. The demand by consumers for a particular technology will set the length of time in which that technology will be considered significant and worthwhile to the possessor.

The timing principle also suggests that even appropriate controls are only viable for a limited period. For an example consider the nuclear nonproliferation commitment of the United States. The capability and complete technology for weapons production is not publicly accessible 40 years after its development. Yet today, textbooks discuss the implosion theory and generally describe fission processes, once carefully controlled information. The timing principle merely indicates that at some time one must be prepared to change control requirements on a technology. As a matter of fact if controls are placed on a technology, it is important to delineate the period of time or conditions under which the controls should be reviewed, revised, or deleted.

Significant exceptions to this timing principle are the complementary gasoline/automobile industries. Generally gasoline production processing has not changed significantly in the past century with the exception of unleaded fuel, which was not initially endorsed by the oil companies. Certainly they are not prepared to let the technology of cracking plants subside—a market still exists and will exist as long as the world supply of oil is significant.

Oddly enough, this process of letting go and long-term planning is not accomplished well by the US democratic government; the free economic and political atmosphere of the United States has just the opposite effect on commercial companies and entrepreneurs. They know that their product or expertise has a finite life, so they plan for its demise or at

least program an updating to make it more attractive again. Very few successful companies hang on to just *one* technology forever. Timing implies an eventual end to the utility of a technology—at least for profit motives. Thus we encounter the principle of relinquishment.

3. **RELINQUISHMENT**—The control of a unique technology must be reduced, revised, or terminated at some point in the life of the technology. This aspect should be planned, reviewed throughout the product's lifetime, and adhered to without question when that relinquishment is seen as the best procedure.

The principle of relinquishment relates to the principle of timing because it requires that we consider the entire lifetime and appropriate demise of a particular control. In industry, control of a particular manufacturing technique or engineering process that provides a profit margin is equated with the lifeblood and longevity of the company.

But when a particular drill press, for example, is outmoded or surpassed, the company surely will acquire a new one and sell the capability that was protected for so long. The company will relinquish the system, perhaps even to a competitor, if the next state-of-the-art system will advance production and protect its current market position.

This cycle of replacement by the newer technology has been modernizing world industry since the Industrial Revolution. Another effect is the driving need for industry leaders to improve on a product, increase the efficiency of its production, or to transfer expertise and effort into a related technology.

The previous principles have dealt with control, timing, and relinquishment and their various facets. But the status of the people and the political entities involved in the transfer of technology is just as important. Technological motivation has been mentioned only in connection with the sense of a company's failure to produce. The real motivation for both sides is profit (or loss) of the negotiations.

4. **PROFIT (OR LOSS)**—Participants in technology transfer experience an actual or perceived gain (or loss) from the transaction.

The realized or perceived gain, or loss if that be the case, depends on the degree of satisfaction achieved by both buyer and seller. Good technology transfer will be referred to as "positive" technology transfer. In the case of good transfers, reciprocal profit may occur for the parties involved. For example, a particular technology may be bought from the United States at a sound price. The technology may be used by the buyer nation to expand its own economic base and to improve production capability: the purchase of US farm machinery by a Third World nation to expand and improve its food production, for example. The success of this scenario certainly would be interpreted as a positive technology transfer. Other potential outcomes also exist.

The alternative outcomes are important to consider. Farm machinery conceivably could be sent to a country that would be technically incapable of maintaining and repairing the system. Certainly the machinery would not bring profit or improved circumstances to the buyer country, if it were unsupportable. In this case we have neither a positive nor negative transfer, but a technology transfer that never was properly

planned for, or never was executed correctly. Certainly, one outcome would be a diminished international image of US farm equipment technology.

Another aspect of the principle of profit—or loss—is the negative transfer, sometimes called *bad* or *undesired* transfer. It is the cause of all the recent furor over technology transfer and controls. The Soviet Union has used negative technology transfer for many years. For one example, by the year 1924, based on the purchase of Fokker drawings, a de Havilland prototype, and foreign-manufactured engines, the Soviets were able to produce their own wooden aircraft. Machine tools came from a Danish source and sprucewood from Washington State.

They took the technology from other countries.

And a later example: Following the forced landing of a B-29 bomber in the Soviet Union after a raid on Japan, the Soviets produced an exact copy, the Tu-4, in substantial numbers. The redesigner, Tupolev, allegedly referred to it as the "locally built Boeing product." A major technology transfer problem for the United States is the Russians' pirating of today's high technology without payment or payment in kind.

In summary, the communication, innovation, energy, and sincerity of each party involved are essential to positive transfer. Information sharing, while necessary to fuel the technological engine, must be what it says it is—reciprocal transfer.

5. **STATUS**—A technology's importance or relevance is in proportion to its stage of development (basic, developmental, exploratory, advanced, or production).

When a technology is in the advanced or production phase, theoretically it increases in value to buyer

and seller. Although the basic research process is the genesis of technology, somewhere between discovery, exploratory applications, and production the technology evolves from idea to profit-making innovation, from theory to monetary or other national security value. Thus a corollary to the principle of status: *no control should be placed on basic research.*

The scientific world really is connected through paper presentations, verbal communications, and joint-venture basic research projects. A recent National Academy of Sciences report on technology transfer issues stresses the need to protect the academic freedom of discussion and interchange.

A request to classify several recent meetings of the American Institute of Aeronautics and Astronautics (AIAA) occasioned a formal response by the AIAA president, who said that although some special meetings are necessarily classified, future policy would strive to keep meetings unclassified to attract foreign participation. Academic exchange is vital to the long-term technological health of our nation. The United States cannot afford to close scientific communication channels that generate the very ideas that fuel our technological activities.

One important remaining question is: Can we practice restraint in areas vital for control of technology, yet achieve our national goal of technological supremacy? Having now examined these five principles, construction of a statement of national technology transfer policy is possible. In most scientific endeavors, laws and principles lead to broader understandings in a particular discipline. For technology transfer, other principles may exist, but these first five principles suggest that a national policy is possible.

5. A National Policy Model

THE ROAD MAP OF ACTION leading to a national technology transfer policy is not difficult to construct. A national technology transfer policy should be publicly announced by the President of the United States. The appropriate timing of this policy announcement by the President is vital; it should be associated with a major technological advance or a program announcement. The President then should follow this public announcement with a National Security Decision Directive that would unequivocally define executive department responsibilities for executing the policy. The executive branch then must submit legislation to the Congress to support the long-term policy decision and implementation.

Based on the earlier examination of problems and principles of technology transfer, as well as discussions with members of government, industry, and the scientific community, I propose the following policy statement model:

Preamble to the National Technology Transfer Policy

The United States must face the future explosion of technology with a policy that serves the total national, political, economic, and security interests in the broadest and most far-reaching time period possible. In addition to the basic statement, the following four specific areas will be addressed by this policy:

1. *Academic Research.*
2. *Industry and Manufacturing Techniques.*

3. *Trade.*
4. *National Security Concerns.*

National Policy for Technology Transfer

In the interest of all free people on earth, the United States will vigorously pursue economic, political, and social policies that increase positive technology transfer everywhere. This open exchange will promote people-to-people interchanges, and thus enhance the prospects for long-term peace over the entire planet.

Four specific areas of action are necessary:

ACADEMIC RESEARCH The policy of the United States will be promotion of basic research and technical applications that increase mankind's understanding of the universe. This pursuit of knowledge necessarily involves the free exchange of information, postulations, and theory by scientists and research agencies. The US Government and private industries will sponsor basic research and technology advancements in all appropriate scientific arenas.

Further, the US Government will assist the free national and international exchange of information through symposia, reciprocal visitations, cooperative activities with private institutions, and other exchange mechanisms. This policy of expanded exchange will be promoted internationally, as long as other participants involved respond with the same attitude, philosophy, and level of commitment.

INDUSTRY AND MANUFACTURING US industries generally are disposed to control the vital technology

necessary to their continued success. However, certain surrogate companies and agencies of international adversaries will be strictly monitored by the Federal Bureau of Investigation and the Treasury Department, to ensure complete compliance with controls on exports, as defined by Department of Commerce regulations and directions.

Multinational companies that intend to transfer technology to other countries, to better their business positions, will report this specific action to the Commerce Department. If the technology has dual or defense-related use, the Defense Department may be asked to comment on the advisability of the transfer—given that the US Government has a legal right under the law to control that particular technology. Otherwise, the notification will be only for the information of the Government.

TRADE Free and open trade with all countries of the world will be the goal of the national technology transfer policy. Export licensing procedures and regulations will be designed to place minimal constraints on US industry.

This national policy will be used as the catalyst to bring down trade barriers within, as well as outside, US borders.

NATIONAL SECURITY CONCERNS Fundamental security concerns of the United States will take precedence over other policy considerations. Damage, or threatened damage, to the Free World or to US military systems will not be tolerated. Specific controls to

prevent breaches will satisfy the principles of technology transfer.*

However, until legislative and administrative controls are implemented, rulings of a new Technology Council in the Office of Science and Technology Policy will be binding.

Academic exchanges will not be limited, except in the very rare case where a clear and demonstrable danger to the security of the United States exists. Protection of classified information will continue to apply in academic areas where the Government has entered into a contractual agreement with individuals or institutions concerning the sensitivity of the work undertaken.

Major Policy Implications

The foregoing proposed national policy statement is designed to have overarching application to government, industry, and academia. The President of the United States should be the proclaimer, but initiation and use of the policy depend on the agencies of government, our own industry, and private citizens, who must all be united in their response and action on this policy.

In current times, the most credible individual capable of carrying this policy to full implementation is the President.

First, he has the ability to communicate clearly with the public.

Second, in this arena the President has no personal nor political gain or motivation that would taint the policy announcement from the Executive Office.

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*Discussed in chapter 4, these principles will need to be defined in an appropriate document.

Third, the President's Strategic Defense Initiative (SDI) has started a national drive for technical competence in several related defense areas. Implications for technology transfer and cooperation with our Allies are profoundly important to future political agreements, and perhaps to arms control.[13] The President has opened the door for potential policy decisions for sharing this technology with other nations. An overall policy for the long term should precede this type of decision.

Fourth, Soviet bloc countries would be put on notice that continued expansionism and promotion of instability in the world cannot go unchecked. Thus, this policy statement should be presented to our Allies and friends at the earliest possible time for consideration and incorporation in bilateral and multilateral agreements that are contemplated or already in force.

The policy statement should not violate any current international agreements. Further, it is designed to cement technological ties with Third World countries and our friends and Allies in the near term. In the long term, it could be interpreted as a positive gesture toward the Soviets and their surrogate nations. The gesture's positive quality stems from the "apparent" relaxation of access to truly noncritical technologies. The communists might, in fact, reduce some of their efforts to perpetrate technology theft in the United States and other free world nations. Finally, this gesture should reduce the Coordinating Committee workload and make the Committee's restrictions on certain articles more effective.

Once the President has publicly announced a national technology transfer policy, other considerations follow about appropriate support. How can this policy be carried out? The answer involves the Congress and various scientific agencies of the US Government,

such as the National Science Foundation and the National Aeronautics and Space Administration. (The next chapter will be devoted to this very crucial task.)

A second consideration involves legislative implications. The Export Administration Act must be renewed and revised by the next Congress in accordance with this technology transfer policy. Providing the proper legislative package for the Congress is a major step toward implementation of the policy. Passage of an Export Administration Act version is imminent. If the policy statement can be initiated, parts of the current draft might need legislative reconstruction. Legislation also will be discussed in the next chapter on implementation.

SPECIAL LEGISLATION Under the law today a person (or persons) may be tried for espionage, sabotage, or release of classified information. However, the law does not protect the special interests of the United States in the arena of technology disclosure. A special law should be considered for acts of espionage and treason involving the release of classified technical information to our adversaries. This special legislation should be constructed with the help of the DOD and Department of Justice. The law must have special provisions for protection of classified information to prevent the exposure of sensitive pieces of data during investigation, litigation, and potential incarcerations.

The Attorney General should be granted powers to restrict media coverage partially and to provide special protection for witnesses. Such legislation also must restrict the DOD from encroaching on undesignated programs. That is, only a few technological programs would carry the importance to national security that

would allow special prosecution procedures. Should the designation of programs change, new legislation would not be required. However, a special congressional oversight committee should be apprised of all such changes.

Finally, as a check on the process, the Supreme Court, or an appointed group of justices, should promptly review and publicly report its opinion of any special technology transfer policy cases.

In addition to internal support, allied cooperation is important to the announcement of the policy. From 1949, the Coordinating Committee (COCOM) organization has existed to restrain the transfer of arms and valuable military information to adversaries. Since our closest security allies and friends belong to this organization, it behooves the United States to consider the reactions of COCOM members to this policy. Preliminary negotiations and briefings would do much to clear the way.

The real response, of course, will have to wait until actual announcement of the policy. Probably, we could expect the announcement to be well received and viewed as a step toward mutual cooperation and renewed activity in basic research exchanges in all countries. In addition, the simultaneous offering of continued (or perhaps new) technical exchanges with our North Atlantic Treaty Organization and other Allies would greatly speed the acceptance of this policy. As currently postured, however, the statement does not say that we will try to withhold all technology. That important reversal of the current trend to limit exchanges will be sufficient to encourage reception of the policy.

STABILITY Another reason for allied acceptance is the stability it offers. Our relations with Free World countries have been clouded by the four-year reversible cycle of policies that follow our presidential elections. This long-term policy would strengthen our relations with many countries.

Allies and friends of the United States should be encouraged to define and announce their own technology transfer policies. These statements would help to clarify the trade positions of many of the countries. They would provide bases for long-term agreements to reduce trade barriers. As a matter of fact, the potential for lowered trade barriers among the industrialized nations is exciting and worth the whole effort toward this new policy. Further, this US initiative might generate interest in a new charter for COCOM that would strengthen the trade bargaining position of western nations with the Soviet bloc.

Alternatively, the announcement of US policy may have the effect of uniting the concerns of European nations and increasing the effectiveness of the European Common Market. Although the United States is to be concerned first about that unity, in fact the long-term unity of the Common Market, may have political, economic, and defense spin-off potentials that would strengthen the Free World in many attractive ways.

EFFECTS ON THE THIRD WORLD The policy statement outlined at the beginning of this chapter is intended to subsume the concern of low-level technology transfer as well. For example, technical aspects of irrigation taught to people at the edge of the expanding Sahara might assist in slowing the desert's expansion. The capability to build canals and railroads is not high technology, but it certainly is vital to the survival of some Third World nations.

How then will the Third World react to the policy statement given above?

At first, very little reaction will be shown. The explicit use of low- and middle-level technology as a topic does not come up in the suggested statement. High technology always gets top billing. Thus, emerging nations probably will respond with a wait-and-see attitude. But advantages will accrue to the Third World from expanded trade possibilities seen in this policy.

In fact, the United States conceivably might temporarily reverse or restrict its trade activity in return for other positive trade concessions by Third World nations.

EFFECTS ON ADVERSARIES US economic power probably is more widely respected around the world than our military power. This economic power also is feared by our adversaries. What they would do in reaction to an announcement is speculative, but the following scenario is reasonable:

Although the national policies of our adversaries certainly will color the immediate public response to the US announcement of a technology transfer policy, they very well may welcome the chance to have access to US products directly and indirectly in trade. The Soviet preoccupation with—and enormous expenditures to capture and copy much of—our military technology probably would spread slowly to commercial products.

The Soviets can ill afford the continued delay in upgrading the standard of living for their people. Their massive military buildup has cost Soviet citizens and bloc nations dearly. Thus, the potential for increased trade with the United States and its Allies is significant

for them, and worth pursuit. Other Warsaw Pact countries and Soviet surrogates throughout the world probably will follow the lead of the Soviet Union.

EFFECTS ON INTERNATIONAL ORGANIZATIONS Reactions of international organizations, except where they might involve trade agreements between certain nations, probably will not be important. As to trade organizations, political ties and philosophy of the organization most likely will dictate its response to the US national technology transfer policy. Multinational corporations generally will gain from technology transfer and therefore will support its implementation.

Thus, if this nation is ever to implement a policy with a future strategy for technological growth and control, we should act now. The President must begin the process. Cabinet-level officers must agree to that process and his policy statement. The administration must put together a legislative package that provides mechanism for control, and supports the policy. An agency at cabinet or Executive Office level must foster this policy, from institutional establishments through the day-to-day phases of policy execution. All of this action must happen while the daily technology and trade business of the nation continues uninterrupted.

I explained earlier the case for using the imprimatur of the President of the United States for the policy announcement. In the implementation plan, the timing of such an announcement, with another major technical breakthrough (or major adminstration policy statement on science), is crucial to the approval process and to public support.

6. Implementing the New Policy

THE PRESIDENTIAL SCIENCE ADVISER and his Office of Science and Technology Policy are the best catalysts for initial action in the technology transfer arena. The Science Adviser has immediate access to the President, National Security Council, and other ranking members of government. The adviser's duties include advising on policy affecting technology. The appropriate leader for staffing the initial implementation is already primed for this role.

The role also would include the coordination of problems and the means discussed below to their solution while legislation was being hammered out.

1. Current technology policy questions will have technical resolution under the control of a small panel of experts who report to the Science Adviser.

2. The Senior Interdepartmental Group coordinates political and diplomatic decisions about technology policy after the Science Advisory panel has reported its technical findings.

3. The DOD coordinates specific recommendations about technology transfer in accordance with its reponsibilities under the Export Administration Act extension and any other high-level directives.

Why a Change?

Implementation decisions noted above are administrative and do not directly affect technology control

through the enforcement or licensing procedures. Foreseeing the need for controls for specific technology is sometimes difficult because by their very nature you cannot plan the control before you design the product. By the time control becomes obviously necessary, quick action is required to prevent the possibility of negative transfer. However, imagining classified DOD projects on which controls were obviously required from the beginning is not hard. And, where such controls are necessary, the steps from plans, procedures, and regulations to transfer policy must be clearly traceable.

Implementation of controls, however, must not delay export licensing. On the contrary, in keeping with the national policy intent, decision time must be reduced. As noted in *Aviation Week & Space Technology*, the average processing time for export licensing was 20 days on 45,000 cases from September 1984 to early 1985.[14]

The average time should be better and improvements are constantly sought. Although the majority of these cases are processed routinely within a few days, some exceptional cases have terribly long delays. A few of these exceptional cases, like the recently signed nuclear power plant accord with the Chinese, must have greatly reduced delays to allow US industry a fair shot at worldwide competition.

If the United States is serious about control of specific technologies the exceptional-case time must be cut down more. One key to reducing the delays for the exceptional cases is to reduce the list of "critical" items to a reasonable number. The classified Military Critical Technologies List (MCTL) today is about 700 pages long. This document provides guidance to Defense decisionmakers who advise the Commerce and

Treasury departments on licensing decisions or violations of export restrictions. The MCTL also is a guide for anticipated or requested changes to the Commerce Department's Commodity Control List and to the international COCOM Control List. But difficulties arise with implementation.

As an example, consider the intended effect of the MCTL at the final checkpoint, where an inspector or investigator must make a spot decision about the disposition of a box marked "computer parts—spares" headed to the loading dock and consigned to some neutral nation. Although the MCTL is not resident at the export control point, its effects will be felt there. The inspector's problem lies with practical, daily decisions concerning compliance of shippers with regulations and the Commodity Control List.

The potential bureaucratic maze and tangle between national policy and implementation at the working level can be minimized if people at each level of responsibility are reminded of and keep the objective of the policy in mind. To begin this understanding the cabinet officers must agree on certain implementation actions.

Necessary Cabinet-Level Agreements

Two main concerns at cabinet level are the amount of control necessary and the enforcers of the controls. These concerns equate to the cost and resources necessary to fulfill the control directions. I believe that proper policy implementation must assign the Treasury Department full responsibility for all enforcement inside and outside the continental United States.

The Customs Bureau already has the procedures, institutional bureaucracy, and major responsibility for total enforcement under current law. This responsibility must include investigation of violations under all circumstances.

For similar reasons, the Commerce Department is the right agency to have full licensing authority and control. Commerce should be invited to sponsor agents-in-training to serve (at Commerce expense) with Customs agents to gain investigative experience and to understand the implementation problems before they assume licensing duties. Such training would help ensure that licensing decisions were fully consonant with field enforcement capabilities and operations.

Likewise, agents from Treasury might serve short training tours in the Commerce licensing division. This exchange training would benefit both departments and would promote cooperation at the working levels where action on real problems is assigned, undertaken, and completed. Further, the cross hiring at middle and upper management positions between the two agencies would enhance understanding.

DOD and Commerce Department must agree on issues. The timing and control principles suggest that applied controls are subject to the aging process. Hence, the departments should agree that too many controls held too long will damage export markets and therefore weaken the economy in the long run. At the same time, insufficient controls on vital US technology for defense is improper stewardship of our resources and could fatally damage the US long-term security. Defense and Commerce Departments must agree that intense control will be applied to those special technologies with the following characteristics:

1. The technology is high on the Soviet acquisition list or is so important that they would place it very high on the list if they knew about it.

2. The technology cannot be duplicated in a reasonably short time anywhere else in the modern technical community.

3. The timing is right for control. That is, if the technology soon will be "out on the street" for everyone to copy or imitate, then control for a very short period merely to delay Soviet acquisition is not the best decision or the best use of limited resources.

The State Department, too, is intimately involved in the implementation process. The department should list in priority order the countries that require a technology policy statement. As an aside we note that the national policy statement could not be used as anything more than a guide to develop policies on technology transfer for specific nations. The State Department list should do no more than answer the question about where the United States places the priority in technology concerns. This ranking of countries then must go through the Senior Interdepartmental Group to the other departments for technical and procedural reviews. This agreement on priorities between cabinet offices at the Senior level is a vital—hitherto missing—step in implementation.

The State Department regularly should review this list of nations and their priority. Announcements of scientific interest from a country team or from the technical community in the foreign nation itself should trigger review of the priority listing. The Mobilization Concepts and Development Center at the National Defense University has been working on country-specific policies for the DOD for some time. The Center's information would likely help State Department

officials understand how and why some minor changes in the current management review setup would serve State, Defense, and the Senior Interdepartmental Group better.

Unfortunately, no mechanism now exists to transmit such information.

Ultimately, the State Department must take a more active part in forming policy about technology development and its related economic consequences. With the possible exception of China, and a few individuals, Foreign Service officers have not in general taken an active part in formulating or controlling technology transfer policy. Since technology supports one of the major strengths of the United States—our economy—US foreign policy must support technology.

A case in point: The Chinese are newly enlightened about some forms of economic development as the only hope for their social future. They have modified communist doctrine to pursue a better standard of living for their people. This departure from the hard-line Soviet communist system already is showing signs of stimulating tremendous economic growth in Red China. Although the attendant problems of social, political, and military policies are formidable, by the end of this century the existence of proof of a successful economic recovery may swing Third World countries away from enthrallment by any kind of communist economy. What the Soviets do through military strength and power, we can do and have done by economic strength, astute observation, and considered policies.

Some Third World countries have seen enough of the differences between the United States and the USSR to realize that military rule without economic development spells stagnation and poor standards of

living for most nations—capitalist or communist. Although the signs of the times are sometimes heartening for capitalism and for increased individual freedoms, the United States will miss the opportunity to promote capitalism and individual freedoms if we make technology transfer policy totally restrictive as our communist competitors have it. With its international resources, the State Department can provide an essential influence in this process.

To establish meaningful, strong penalties for the misuse of sensitive national security information, a different sort of cabinet-level agreement must be consummated between the Defense and Justice Departments. The Secretary of Defense and the Attorney General must agree to a legislative package that is strict enough to protect "vital national interest" but that still protects basic individual rights and freedoms. This specific legislation must include punishment for divulging specially classified information.

Perhaps deportation and loss of citizenship could be one of the more powerful sentences for criminal activity in technology transfer, when the crime does not merit imprisonment or the death sentence. For those who have rejected their citizenship by their proven act of serious treason or espionage, deportation and loss of citizenship certainly is appropriate. The recent Walker case may add fuel to this smoldering fire. In any event, prosecution should come quickly and sentences should be executed with dispatch.

Finally, the two cabinet officers might agree to an overall priority in decisionmaking. The list below is mine, but since no other list is known it has at least the merit of being suggested first!

1. The foreign policy of the United States must have the highest priority over all technology concerns

that might cause restrictive policies. The only exception to this rule is the provision for special classification mentioned above.

2. To remove any of the topics that are identified under the special protective legislation would require a decision of the National Security Council. That decision or even one to grant a special exception would have to be made before any exchange on that technology could occur.

3. Differences over technical consequences are adjudicated under the current system with the exception that a Technology Policy Council (similar to the President's Economic Advisory Council) makes the final submission and recommendation on a new or unusual technical issue.

4. Each department agrees that any change in its internal policy guidance should trigger a thorough review of the technology transfer policy and strategies as they apply to the country or procedure involved.

As a simple illustration, consider a fictional change of the MCTL in the following way: Because newly improved technology is available and is in the field, fiber optic junctions with electromagnetic pulse resiliency are removed from the MCTL. This internal policy change at DOD would affect the negotiations of some countries with our economic counselors in the embassies or consulates. It also might affect the international market position of the commercial supplier of fiber optics in the United States.

Accordingly, the Commerce Department would note where and with whom other world suppliers are trading. In this manner, a review throughout the government community triggered by one agency's change may enhance US business and economic opportunities abroad. But no real examples like this will be effective

unless we have legislation to permit good control under an expanded trade philosophy.

Necessary Legislation

The Congress has demonstrated interest in the technology transfer process since the mid-1970s. Several recent hearings investigated technology loss to the Soviet Union and evaluated procedures that currently exist under the law to control the transfer to our friends, allies, and adversaries.[15]

These hearings suggest that the key area for legislative action is enforcement. Although the Commerce Department controls licensing, the power of arrest and pursuit of indictment generally lies with the Customs Division of the Treasury Department. Although attempts have been made over the years to fill in and smooth over the operational enforcement chasm that divides these two agencies, at present, no procedurally clear enforcement system exists between the two agencies. To remedy that deficiency the legislation of national technology transfer policy should follow the suggestions of the congressional inquiries. The committee suggests that if the Commerce Department handled the majority of licensing and preparatory negotiations for industrial trade overseas, it would serve as the one authority and inquiry point, thereby reducing the confusion for foreign and US businesses.

If the Customs Service handled special cases and suspected espionage involving surrogate companies, it could exercise its special relationships with other similar organizations all over the world. In addition, it would be able to expand its capability to cover intentional violations of export regulations. Right now, insufficient resources prohibit a complete job in this

important area. These proposals mean that the Commerce Department should be in charge of and have jurisdiction over all activities up to the actual shipment. After that, the Customs Service should have the responsibility, authority, and resources to enforce the policies, laws, and agreements.

Under the legislation proposed, a special provision should be added for the protection of *extremely sensitive* national security information. This portion of the law would provide for excluding from public judicial proceedings up to five projects (subjects, technologies, and so forth). The rights of the accused violator of extremely sensitive national security information would be carefully controlled by the Congress and Attorney General. That is, the nature of the violation is such a severe transgression of national security that the transgressor's rights will be guarded by the Congress and the Attorney General.

This special security legislation must be a separate package because the delicate issues therein may take years to test in the courts and they should not block the timely implementation of national policy on technology transfer.

The legislation also might provide a personnel limit for the enforcement agencies. It mandates the fiscal reporting process that would guarantee public access to the program cost of all technology transfer control. This unified budget would become the responsibility of the Office of Science and Technology Policy in the Executive Office of the President.

Necessary Attitudes for Implementation

Throughout the implementing period, each step must be a long-term reinforcement of US technology.

Convenient short-term decisions that do not materially advance the technological position of the United States must not be permitted.

Positive results may be achieved in many ways. As a pertinent example, take the corporation recently facing a multimillion dollar contract loss to an international customer. The export controls blocked the contract completion (delivery of a study document) because someone was concerned about the national security implications of certain technical information provided or implied by the calculations. The controlling agency (DOD) recommended that the information be removed.

Of course, doing so would have made the study document meaningless. As a final resolution to this standoff, the company published the exact information in a technical journal that belonged to a respected scientific agency within the US Government. The journal copy passed security review. Then the journal copy was delivered to the customer overseas with a bill for completion of the contractual obligation. This unusual but true case indicates that the rules as they now stand are not practicable. Further, the current rules do not ensure practical security.

The Secretary of Defense has outlined a workable procedure for the priorities process in the implementation of national transfer policy. In his fiscal year 1986 *Report to the Congress*, Defense Secretary Caspar Weinberger said,

> This administration takes a two-step approach toward the technology transfer issue. *First*, to the maximum extent possible we would promote sharing of military technology with our friends and allies. *Second*, we apply specific controls to prevent the loss of that

technology to the Soviet Union and other Warsaw Pact nations.[16]

These internal priorities could govern the construction of policy for US industrial export of high technology.

Agency Responsibilities

• **Office of Science and Technology Policy** The Office of Science and Technology Policy will be the key to implementing the technology transfer policy by integrating administration actions to get the new policy started. Next are the proposed legislation and congressional action to accomplish the long-term goals of the policy.

Without an overseer for this action, the balance between agencies (the agreements mentioned before as an example) would surely be uneven. Such an imbalance would place the entire implementation in jeopardy and potentially leave the United States open to unfair or overly aggressive practices by other nations or international companies.

The Office also will need to oversee the advice of an independent science review council to assure that the technical input to each interim decision is kept apart from the political or institutional bias of any agencies or companies.

• **Department of Defense** Very important specific actions for implementation will fall to the Department of Defense (DOD). In particular, those officials who make technical judgments about the importance of technologies to US military equipment will get more visibility. The DOD will have to refine the MCTL to be more useful to the enforcement agencies and licensing authorities.

As noted in congressional testimony (in the Senate in 1982, in the House in 1983), DOD must reduce the MCTL to the essential technologies to be protected. The Bucy Report *(1976 Defense Science Board Report)*[17] strongly indicated that DOD should limit the list of protected items to those manufacturing technologies and quality control techniques that, if transferred, would allow our adversaries to replicate quality products with success and profit, or military application. As Defense Secretary Harold Brown wrote,

> the primary objective in the control of exports of US technology is to protect the United States' lead-time relative to its principal adversaries in the application of technology to military capabilities.[18]

Although DOD already has proposed the technical method and objective to reduce the MCTL, it has not been done. Why? It has been stalled by the same blockage that prevents US policy decisions and quick actions on requests to license exports. It is the same blockage that delayed a decision on technology transfer to the People's Republic of China for at least three years.

That blockage results because no acceptable procedural decision process exists today to coordinate all the departments of government or to specify at what level decisions will be made or reviewed. DOD could take a lead right now by reducing the MCTL as a first step toward implementing the technology transfer policy.

- **National Security Council** A National Security Decision Directive (NSDD) is needed to institutionalize the process. Figure 3 shows the major players in this process.

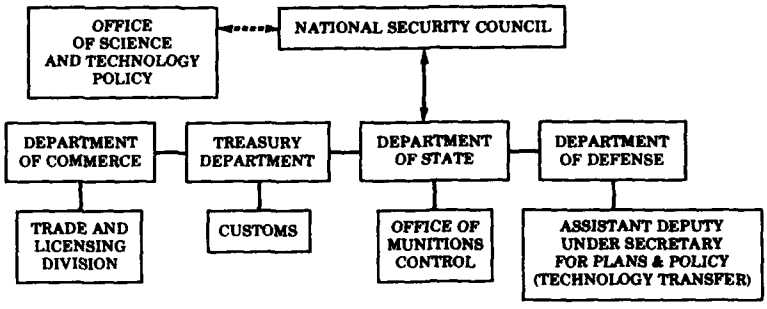

Figure 3. Technology transfer institutional hierarchy

Figure 4 indicates the general policy process that must be followed to create a viable, long-lasting policy.

Note that an evaluation and feedback mechanism allows those in the decision process to learn, to correct errors, and to expedite decisions that have commonality in time or content. The NSDD must assign this interim responsibility to the Office of Science and Technology Policy.

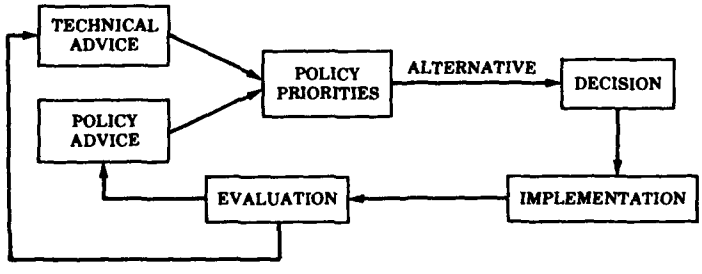

Figure 4. Technology decision process

• **Department of Commerce** The Department of Commerce will be crucial to successful implementation. Applications for export licenses would be processed routinely unless they were not covered by normative policy. Then the action to raise the question to the first decision level should be speedy and should not penalize the exporter. Despite the reduction of people involved, numerous examples demonstrate the business loss for US companies because of a slow decision.

A valuable contribution that the Commerce Department will make is its continued streamlining of the Commodity Control List. Further, the department's management of its decision time will improve as automated information retrieval and requests between the advisory agencies become increasingly available. One positive initiative that the department recently has used is a prerequest advisory on the probability of licensing or the anticipated delay. These advisories assist companies in making realistic proposals to international concerns.

• **Department of State** In general, foreign policy decisions must take precedence over technical judgments. As an example, questions about transferring nuclear energy technology qualify as special cases where our foreign policy commitment to nuclear nonproliferation would override military considerations.

• **Central Intelligence Agency** The Central Intelligence Agency assesses the capabilities and potentials of our adversaries worldwide. In particular, the Technology Transfer Intelligence Committee assesses the priorities that adversaries assign to

acquiring our technical understandings and capabilities. The implementation of national policy certainly must include the Committee's advisories in any technology transfer decision. The Committee should report to an Advisory Council within the Office of Science and Technology Policy.

Enforcement: A Major Question

A major policy choice in this whole question is one of *enforcement*. The question is should the enforcement of technological transfer control be a random checking of the system or is a complete control apparatus necessary? For many reasons the latter choice is simply unacceptable. It is too expensive. It increases the size of government in contradiction to the policy of President Reagan. It carries the taint of a police state activity where controls are the rule and not the exception.

If selective controls are accepted, then what controls should be implemented and enforced so that both US security and proprietary interests can be protected? To answer this question, experts in the intelligence community already are at work. As the 1982 and 1983 congressional inquiries reveal, the intelligence organizations of the United States can project with reasonable accuracy just what the Soviets or other adversaries might want to steal or copy. Given that we have some knowledge of these priorities, it seems reasonable that concentrated protections would thwart or limit their technological espionage. At a minimum, concentrated protection would increase the cost of their acquisition of the knowledge. The intelligence community's findings might be updated in the implementation period. If

this is the inappropriate time, experience with the operations should dictate the appropriate moment.

Industries must play in this serious game of control as well. Naturally, they will protect their proprietary rights and the manufacturing capabilities that assure their favorable profit margin. But at some point in the sale of a quality-control procedure for a chemical process, for example, the security interests of the United States might take precedence. In such a case, as a measure of cooperative partnership with the Government, the industry could modify the process sufficiently to market it without exposing US security concerns.

The academic community, too, must be a part of the cooperative effort to protect America's interest. The university and college study atmospheres which allow nearly free exchange must be diligently protected. Only an unequivocal danger to US security should interfere with international free exchange of academic work, papers, and speculation. The universities and colleges have already made statements to the National Science Foundation Study on Academic Freedoms supporting free exchange while recognizing the potential conflicts that might arise.

As an example of cooperation, scientific exchanges that portend major changes in the capability of an operational weapons system might be reported to the Defense Department for further study without endangering the academic status of any individual or institution. Implementation of a long-term national policy such as I have proposed will assist the academic and scientific community in answering questions about technology transfer.

The pieces are in place for action that will be in the best interest of the United States and its long-term

security and economy. We cannot afford to dawdle until it is not a question of how we play the game but whether we win or lose.

Endnotes

Chapter 1

1. The COCOM (Coordinating Committee) organization is a voluntary group of industrial nations consisting of all NATO countries, less Iceland and Spain, but including Japan. It was formed in the 1950s to stave off unnecessary transmittal of military systems and materiel to the Soviet Union and communist-bloc nations.

2. *Report of the Technology Transfer Committee*, House Committee on Armed Services, 98th Congress, 2nd Session (Washington, DC: US Government Printing Office, 1984).

3. US Department of State, *Atlas of United States Foreign Relations*, Bureau of Public Affairs, Washington, DC, 1983.

4. Richard D. DeLauer, "Scientific Communications and National Security," *Science*, 5 October 1984, p. 9.

5. George W. Sutton, editorial, "National Publication Policy," *AIAA Journal*, Vol. 24, No. 1, January 1986, p. 1. Sutton "shared" excerpts of his letter to *Aerospace America* with readers of the editorial, and then added some thoughts. These quotes are from his letter.

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6. *Technology Transfer*, hearing before a panel of the House Committee on Armed Services, 98th Congress (Washington, DC: US Government Printing Office, 1984), page 57.

7. Paul Mann, "US Tallies Cost to Soviets of Technology Transfer Rules," *Aviation Week & Space Technology*, Vol. 121, No. 24, 10 December 1984, pp. 67–69.

8. Jack Baranson, *Technology and the Multi-Nationals* (Lexington, Mass.: Heath and Company, 1978).

9. *Technology Transfer*, hearing, p. 58.

10. Harold B. Holland, et. al. eds., *Management of Security Assistance* (Dayton, Ohio: Wright-Patterson Air Force Base, Defense Institute of Security Assistance Management, 5th edition, 1984).

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Chapter 3

12. Arthur E. Fajans, "Stronger Safeguards for US Technology," *Defense*, March 1985, p. 19.

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Chapter 6

14. James K. Gordon, "Three Agencies Will Cooperate to Cut Export License Delays," *Aviation Week & Space Technology*, Vol. 122, No. 18, 6 May 1985, p. 104-6.

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17. Defense Science Board, *An Analysis of Export Control of US Technology—A DOD Perspective* (Washington, DC:

Department of Defense, February 1976). This report was called the "Bucy Report" after J. Fred Bucy, executive vice president and chief operating officer of Texas Instruments, Dallas, Tex., who chaired the committee. The report is an important and unanimous industry input to DOD, indicating that manufacturing technology and quality control are truly critical items to be monitored in avoiding unwanted technology transfer to US rivals or adversaries.

18. Harold Brown, "Interim DOD Policy Statement on Export Control of United States Technology," *SECDEF MEMO to Secretaries of Military Departments*, 26 August 1977, p. 1.

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Callaghan, Thomas A., Jr. *US/European Economic Cooperation In Military and Civil Technology*. Washington, DC: Center for Strategic and International Studies, 1975. This text argues that NATO nations could save billions of dollars if they would cooperate in their research. The actual mode and method for transfer of technology is not outlined. The idea is intriguing but practicality and implementation are not treated.

Gibbons, John, ed., *Technology and East-West Trade—An Update*. Office of Technology Assessment, US Congress. Washington, DC: US Government Printing Office, 1983. This book reviews the Export Act of 1979 and its effectiveness. Coverage is good and provides a perspective for the current Export Administration Act and its difficulties.

Koons, M. E., James R. McMillan, Donald J. Wheeler, and A. M. Read. *Factors Influencing the Transfer of Government Technology to the Private Sector*, 1974. This industrial cooperation bulletin studies the utility and effects of ICBs on technology transfer from government to industry. No real statement of policy is broached in this article.

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Committee on Science and Technology. *Technology Transfer to China*. Hearings and Report of Subcommittees on Investigations and Oversight and Science, Research, and Technology, US House of Representatives, July 1980.

East-West Trade and Technology Transfer: Toward a Policy of Non-Military Free Trade. Baltimore: Johns Hopkins University *SAIS Review*, Summer-Fall, Volume 4, Number 2, pp. 93-104. This article states that a major overhaul of trade policy is needed. Recent administrations have demonstrated spasmodic, *ad hoc*, and incoherent policies that have confused and angered US friends and allies. Flirtations with economic warfare almost always have been counterproductive for the United States. The strong point is made that nonmilitary trade between the United States and the USSR makes a lot of sense and promotes peaceful exchanges.

Abbreviations

AIAA	American Institute of Aeronautics and Astronautics
COCOM	Coordinating Committee
DOD	Department of Defense
EAA	Export Administration Act
MC	Munitions Control
MCDC	Mobilization Concepts Development Center
MCTL	Military Critical Technology List
NSC	National Security Council
NSDD	National Security Decision Directive
OPEC	Organization of Petroleum Exporting Countries
OSTP	Office of Science and Technology Policy
PM	Program Manager
PRC	People's Republic of China
SIG	Senior Interdepartmental Group
TI	Texas Instruments
TTIC	Technology Transfer Intelligence Committee
US	United States
USSR	Union of Soviet Socialist Republics

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The Author

Colonel Philip A. Roberts, US Air Force, Retired, is general manager, Dayton, Ohio, Operations, Technical and Management Services Corporation (TAMSCO). Prior to retirement, he was director of the B-52 Project Office at Wright-Patterson Air Force Base, Ohio. He wrote this essay while a research fellow at the National Defense University and a student at the National War College.

Dr. Roberts earned the BS degree in engineering science at the United States Air Force Academy; he also earned MS and PhD degrees from Purdue University, where he concentrated on aerospace guidance and control problems. He taught mathematics at the Air Force Academy.

Colonel Roberts is a pilot and holds paratrooper and missileman ratings in the Air Force. He has served as a special projects technology officer in the Office of the Air Force Deputy Chief of Staff for Research and Engineering, and is vice president and a member of the Board of Directors of the National Technology Transfer Society.

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